

Stave Assumptions

$$L1 := 13\text{in} \quad a1 := 3.25\text{in} \quad a2 := L1 - 2 \cdot a1 \quad a2 = 6.5\text{in} \quad x1 := a1 \quad x2 := a2$$

$$Msi := 10^6 \text{psi} \quad E := 55Msi \quad \nu := .017 \quad c1 := 4.85\text{mm} \quad t := .027\text{in}$$

$$h1 := c1 + 2 \cdot t \quad h1 = 6.222\text{mm} \quad b := 7.17\text{cm} \quad \text{width} \quad h1 = 0.245\text{in}$$

$$D := \frac{E \cdot t \cdot (h1 + c1)^2}{8 \cdot (1 - \nu^2)} \quad D = 3.986 \times 10^3 \cdot \text{Pa} \cdot \text{m}^3 \quad D = 3.528 \times 10^4 \cdot \text{lbf} \cdot \text{in}$$

$$G_c := 1.28 \cdot 10^8 \text{Pa} \quad G_c = 1.856 \times 10^4 \cdot \text{psi}$$

$$B := G_c \cdot \left[h1 \cdot \frac{(h1 + c1)}{2 \cdot c1} \right] \quad B = 9.09 \times 10^5 \cdot \text{Pa} \cdot \text{m} \quad B = 5.19 \times 10^3 \cdot \frac{\text{lbf}}{\text{in}}$$

Deflection based on two 5.925 lb loads at the quarter points

$$\text{Let total force be } 11.85\text{lbs, } 5.925\text{lbs per side} \quad P := 5.925\text{lbf}$$

$$\delta_4 := \frac{P \cdot L1^3}{96 \cdot b \cdot D} + \frac{P \cdot L1}{8 \cdot B \cdot b} \quad \delta_2 := \frac{P \cdot L1^3}{48 \cdot b \cdot D} + \frac{P \cdot L1}{4 \cdot B \cdot b}$$

$$\delta_4 = 2.019 \times 10^{-3} \cdot \text{in} \quad \delta_2 = 4.037 \times 10^{-3} \cdot \text{in}$$

$$\textcolor{red}{LBNL measurements} \quad \delta_{m4} := 2.675 \cdot 10^{-3} \text{in} \quad \delta_{m2} := 4.65 \cdot 10^{-3} \text{in}$$

$$\frac{\delta_{m4}}{\delta_4} = 1.325 \quad \frac{\delta_{m2}}{\delta_2} = 1.152 \quad \textcolor{red}{central deflection is within 15\%}$$

Facing stress

$$\sigma_{max} := \frac{\frac{P \cdot L1}{8}}{\left[\frac{b \cdot t \cdot c1 \cdot \left(\frac{c1}{2} + t \right)}{\frac{h1}{2}} \right]} \quad \sigma_{max} = 4.561 \times 10^6 \text{Pa} \quad \sigma_{max} = 661.583 \cdot \text{psi}$$

$$\sigma_{avg} := \frac{P \cdot L1 \cdot (c1 + h1)}{16 \cdot b \cdot t \cdot c1 \cdot h1} \quad \text{average facing stress} \quad \sigma_{avg} = 588.658 \cdot \text{psi}$$

Shear stress

$$S1 := \frac{P}{2} \quad \gamma_s := \frac{2 \cdot S1}{b \cdot (h1 + c1)} \quad \gamma_s = 3.32 \times 10^4 \cdot \text{Pa} \quad \gamma_s = 4.815 \cdot \text{psi}$$

Shear strain $\gamma_{\text{core}} := \frac{\gamma_s}{G_c}$ $\gamma_{\text{core}} = 0.026 \cdot \%$